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STERILIZED MILK.

A REPORT OF SOME EXPERIMENTS MADE TO DETERMINE THE PROPER MANNER OF BOILING AND PRESERVING MILK FOR THE USE OF INFANTS.*

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In Nos. 15 and 16 of the *Münchner Medizinische Wochenschrift* (1886), Dr. Soxhlet reports his experience in preparing and feeding sterilized milk, and describes an apparatus by means of which the procedure can be practically carried out in every household. This communication does not seem to have attracted attention on this side of the Atlantic, for I have never heard it spoken of, and have never seen a press notice of the subject in any of our journals.

During my vacation last summer I met at Wurzburg, Bavaria, a very reputable colleague who is particularly interested in *Pædiatrics*, and, in the course of conversation, he made mention of sterilized milk, expressed his surprise that little attention was paid to this matter in the United States, and spoke very highly from personal experience of Soxhlet's apparatus. The gentleman was kind enough to introduce me to the parents of two of his little patients who were fed on sterilized milk, and I ascertained, by directly questioning the mothers, that they had no difficulty whatsoever in manipulating the milk according to directions.

Subsequently I met at Carlsbad, Bohemia, another colleague, who confirmed the statements of my friend at Wurzburg, and who assured me that he frequently ordered the sterilizing apparatus in his practice. These statements induced me to import a set of Soxhlet's utensils, with a view of carefully investigating the subject from a practical standpoint.

Before giving the results of my observations I will refer briefly to the theoretical part of our subject. The investigations of Lister show that the milk in the cow's udder is aseptic, and the same is true of milk within the human female breast, according to Escherich.

Soxhlet, in his article, says: "During the process of milking, particles of manure and other forms of dirt get into the milk, and, during transportation and general handling, fermentation sets in, so that much of our milk is really unfit for consumption before it gets into the hands of the consumer—*i. e.*, into the stomachs of infants and children. Mothers' milk, on the contrary, is taken directly, and would, undoubtedly, be equally contaminated and frequently injurious to infants if it suffered the same manipulation as cows' milk," and he quotes the well-known fact that calves fed on milk from a trough frequently suffer from diarrhœa.

Dr. Soxhlet does not fully consider the difference in composition between cows' milk and human milk, but otherwise his reasoning appears to me to be sound.

* Read at the meeting of the Pædiatric Section of the N. Y. Acad. Medicine, Feb. 22, 1888.

He proposes, therefore, to sterilize all milk for children's use, and his method is as follows:

Description of Sterilizing Utensils.

1. Twenty well-annealed 5-oz. bottles, with stoppers of rubber and glass combined. The rubber stopper fits well into the neck of the bottle and is perforated, in order to admit a slender glass stopper.

2. Wooden stand with zinc dripping pan for inverted reserve bottles, and provided with a drawer for extra corks, nipples, etc.

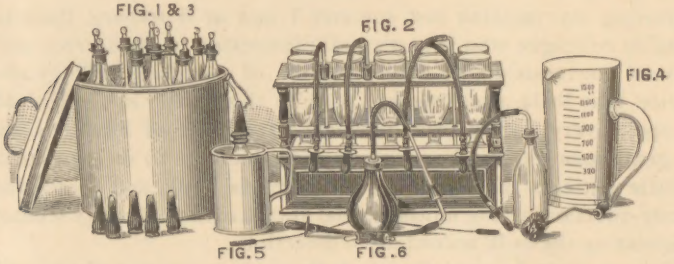
3. A tin or galvanized tray for ten bottles of milk, which fits into a tin pot half-full of water, which is made to boil in the ordinary way.

4. A graduated glass pitcher, for mixing the milk with water, etc., in certain proportions.

5. A water bath, for warming each bottle of sterilized milk before using it, consisting simply of a tin cup with perforated double (inner) bottom.

6. Bag-syringe, with nozzle for injecting soda solution through feeding-tubes, when such are used.

Finally, bristle brushes, for cleansing bottles, tubes, etc.



Modus Operandi for Sterilizing Milk.

Ten bottles are filled with milk to within half an inch of the neck. Into each bottle a perforated rubber stopper is pressed. The bottles are placed in tray No. 3, which is set in a pot of water. After the water has come to a boil, and expansion has taken place, the glass stoppers are pressed into the perforated rubber stopper, thus hermetically closing each bottle. The milk remains in the boiling water fifteen to twenty minutes longer, and is for that length of time under pressure in a temperature of 212° F., which is sufficient to destroy all germs and impurities liable to produce fermentation. Milk so prepared will keep sweet four to six weeks, according to Soxhlet.

When the milk is to be used, the bottle is put into hot water for a few minutes, until the contents are warm. The stopper is then removed, and an ordinary nipple attached. A long feeding-tube may also be used in the usual way, if desirable. Milk remaining in the bottle after the child has been fed is thrown away.

Indications for the Use of Sterilized Milk.

1. Sterilized milk should be administered to all children deprived of the breast.

2. It may be given to children suffering from diarrhœa or convalescent

from cholera infantum, when milk boiled in the ordinary way is not tolerated.

3. A supply of sterilized milk is of the utmost importance for children while traveling.

I have been told that in Munich about one thousand families have this apparatus in use; it is also recommended by many physicians throughout Southern Germany. The price of Soxhlet's utensils is $5 in Munich; with freight and duty, $8 in New York.

Experiments.

During the past four weeks I have made careful experiments in sterilizing and boiling milk, with a view of determining the proper manner of boil- and preserving milk for the use of infants, with the following results:

1. Milk sterilized in Soxhlet's apparatus, boiled 30 minutes, remained good 18 days.

2. Milk boiled in small bottles for 15 minutes—before removing from the boiling water, the bottle was closed with a pledget of cotton. This milk remained good 5 days.

3. Milk boiled in small bottles for 15 minutes; then taken from the water, and each bottle closed with a tight, non-perforated rubber stopper. This milk remained good 5 days.

4. Milk boiled in small bottles for 15 minutes; then taken from the water, and each bottle immediately closed with a good quality cork stopper. This milk remained good 5 days.

5. Milk boiled in a pot, and put into small bottles after cooling, and closed with cork stopper. Sour after 4 days.

6. Milk boiled in a pot, and put into small bottles after cooling, and closed with non-perforated rubber stopper. Sour after 4 days.

[This milk was kept in a spare room with temperature ranging from 50° to 70° F. Samples of milk from these experiments were shown to and examined by members of Pædiatric Section of Academy.]

7. Milk boiled in a pot in the usual manner and left standing in an open dish in a room with a temperature of 75° F.: (*a*) ordinary store-milk had a distinct sour taste and smell after 8 *hours;* (*b*) good "bottle-milk" "turned" after 15 hours.

8. Milk boiled in a pot in the usual manner and placed in the ice-box in an open dish: (*a*) ordinary store-milk "turned" after 18 hours; good bottle-milk "turned" after 26 hours.

Before proceeding I desire to call attention to the different results obtained by Soxhlet and myself regarding experiments Nos. 7 and 8, and would emphasize that Soxhlet has investigated the *curdling point*, his investigation showing that milk *curdles* in 40 hours at 64° F., and in 19 hours at 88° F. At 95° F. milk curdles 330 per cent. more rapidly than at 58° F., fermentation setting in very rapidly at a temperature of 95° F. I have paid no attention to the curdling point, because curdled milk, as a rule, is not fed to healthy infants. It was my object to ascertain as near as possible the point at which a change takes place in ordinary good milk under ordinary circumstances, which change should be perceptible to taste and smell, as a good and practical test of the condition of milk, and superior to the litmus-paper

test. The latter test I have found to be unreliable, inasmuch as milk which is just sour enough to be unfit for use will *not* turn blue litmus paper red, such a color-change taking place only when milk is very sour and curdled.

The milk used was of a very good quality, such as is sold in New York at 10 cents per bottle (quart), and is delivered in bottles closed with good quality cork stopper, except in two instances, as reported in Experiments Nos. 7 and 8, when store-milk was used. The sterilizing bottles were absolutely clean, and all stoppers used were put into boiling water before using.

No difficulty was experienced in sterilizing milk No. 1, except that in two bottles the pressure loosened the glass stoppers, on account of the softening of the rubber by the heat. This can be avoided by pressing the rubber stopper well into the neck of the bottle.

In consequence of these experiments I have arrived at the following conclusions:

1. The preparation and administration of sterilized milk can be managed in any well-regulated household.

2. The boiling of milk for 20 to 30 minutes under slight pressure, in small bottles hermetically closed, is all that is necessary to practically carry out the principle involved in sterilization—*i. e.*, to destroy the germs of fermentation.

3. The essential materials are: small bottles with Soxhlet's stoppers and a tray.

4. Milk boiled in small bottles for 20 minutes and immediately closed by rubber, cork or cotton stoppers, will keep sweet, if put on ice, for several days.

5. The boiling of milk in the ordinary way is faulty. All milk for infants' and children's use should be boiled in small bottles* in a water bath for 20 minutes, when it will keep much longer than if boiled in the ordinary way and the usual length of time.

6. The transportation of milk should take place in refrigerator-cars during the summer months. This should be secured by legal enactment.

7. An apparatus for properly boiling and preserving milk for infants' use should be at once introduced into every well-regulated household. The essential utensils are: small bottles (5 to 6 oz.) with combination stoppers (Soxhlet's) and a tray of tin or galvanized iron—all procurable for a very moderate sum. A good brush for cleaning the bottles should accompany each set; also a tin dipper, with perforated inner bottom, for warming the milk before giving it. Ten spare bottles, with a few ordinary nipples, would make the outfit complete. To facilitate handling and transportation, such an outfit could be packed in a wooden box one foot square and high, and provided with a common handle. All the other utensils, as advised by Soxhlet, are superfluous, the more so, as complicated apparatus is difficult to introduce for family use and soon discarded. Feeding-tubes are difficult to keep clean, and should not be used. The ordinary nipples for sale everywhere will fit the bottles, and such nipples can be turned inside out and thoroughly cleansed. It would be a good plan to stamp into the tin cover of the boiling pot: *Boil for twenty minutes*, this being important in view of the fact that the printed directions are liable to be lost or mislaid.

* About thirteen years ago Dr. A. Jacobi recommended that milk should be boiled and put into *small* bottles, tightly corked, and kept on ice upside down. See also A. Jacobi, "Intestinal Diseases of Infancy and Childhood," 1888.